Determinants of inequalities in life expectancy : an international comparative study of eight risk factors

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	North Europe				East Europe				South Europe		West Europe				Europe mean*	
	Denmark	Finland	Norway	Sweden	Estonia	Hungary	Lithuania	Poland	France	Spain	Austria	Belgium and Wales	Netherlands England	Switerland		
Men																
Father with a manual occupation	4•4%	2•5%	3•5%	4•2%	1•8%	2•0%	1•4%	1•0%	5•4%	5•3%	4•5%	6•4%	4•1%	4•1%	3•1%	3•5%
Low income	6•1%	9•3%	5•9%	6•6%	7•3%	12•1%	10•7%	11•4%	8•3%	11•4%	8•7%	11•6%	8•3%	9•2%	10•6%	9•7%
Few social contacts	0•2%	2•8%	0•8%	1•2%	0•8%	0•6%	0•4%	1•2%	1•7%	0•9%	1•2%	0•5%	0•3%	0•9%	0•8%	0•3%
Smoking	15•9%	26•7%	24•9%	24•8%	29•3%	32•1%	18•3%	12•7%	23•0%	16•6%	18•9%	33•2%	20•6%	23•4%	8•9%	19•8%
High alcohol consumption	1•7%	1•8%	0•5%	0•6%	1•0%	1•1%	7•1%	0•9%	2•8%	3•5%	1•4%	2•8%	0•9%	0•0%	0•6%	1•4%
High bodyweight	9•4%	6•9%	5•6%	13•7%	1•1%	1•4%	7•3%	3•0%	10•2%	14•6%	11•2%	5•9%	9•6%	8•7%	7•8%	7•6%
Low physical activity	3•2%	3•4%	0•6%	4•4%	4•6%	0•9%	6•3%	2•6%	1•7%	2•2%	7•7%	3•3%	4•1%	4•8%	5•5%	0•7%
Low fruit and vegetable consumption	6•3%	3•7%	5•5%	8•4%	3•0%	3•4%	7•7%	0•8%	3•7%	4•0%	0•9%	6•1%	7•1%	0•4%	5•4%	3•7%
Women																
Father with a manual occupation	3•8%	3•1%	5•3%	5•7%	0•7%	3•7%	0•7%	0•3%	4•6%	6•1%	9•1%	8•3%	7•4%	7•0%	5•5%	4•5%
Low income	7•1%	9•1%	10•4%	8•3%	8•4%	16•0%	10•1%	15•5%	13•6%	19•1%	14•4%	17•4%	11•3%	13•1%	15•2%	13•4%
Few social contacts	1•6%	0•5%	2•2%	0•2%	0•9%	0•5%	0•6%	0•1%	4•3%	4•6%	3•3%	2•3%	0•7%	1•1%	3•1%	1•2%
Smoking	19•2%	33•2%	35•5%	20•0%	27•1%	27•7%	6•5%	15•5%	3•8%	8•0%	35•1%	42•5%	30•0%	28•5%	21•4%	18•9%
High alcohol consumption	0•1%	0•3%	0•4%	0•6%	1•3%	1•1%	0•6%	0•3%	0•3%	0•8%	1•1%	0•6%	1•4%	0•3%	1•5%	0•5%
High bodyweight	7•1%	12•8%	11•9%	10•3%	11•3%	7•6%	10•9%	4•7%	19•2%	32•1%	15•5%	9•6%	8•9%	15•8%	6•2%	11•7%
Low physical activity	2•6%	1•8%	1•3%	0•4%	1•3%	0•5%	3•9%	3•7%	2•0%	3•9%	11•2%	1•5%	6•9%	0•8%	2•4%	2•5%
Low fruit and vegetable consumption	5•1%	8•2%	3•7%	7•8%	5•9%	6•5%	9•3%	7•0%	5•0%	8•6%	8•1%	4•8%	9•7%	5•8%	0•2%	7•0%

Gap is calculated as the percentage difference between the observed gap in partial life expectancy between 35 and 80 years of age and the gap in a counterfactual upward levelling scenario in which the prevalence of each risk factor among the low educated is the same as that among the high educated in the same country. *Population-weighted mean of all European countries in the analysis.

Table : Change in gap in partial life expectancy according to upward levelling scenario, by gender, country, and risk factor

	Main analysis*	Sensitivity analyses				
		Best practice scenario	No correction father's occupation for adult education	Higher mortality relative risk for income	Lower mortality relative risk for obesity	Rehm et al[18] correction for alcohol consumption
Men						
Father with a manual occupation	3•5%	2•0%	6•7%	••	••	••
Low income	9•7%	0•0%	••	15•5%	••	••
Few social contacts	0•3%	1•1%	••	••	••	••
Smoking	19•8%	2•7%	••	••	••	••
High alcohol consumption	1•4%	1•3%	••	••	••	0•1%
High bodyweight	7•6%	3•4%	••	••	2•7%	••
Low physical activity	0•7%	2•9%	••	••	••	••
Low fruit and vegetable consumption	3•7%	1•9%	••	••	••	••
Women						
Father with a manual occupation	4•5%	1•6%	8•5%	••	••	••
Low income	13•4%	4•7%	••	21•1%	••	••
Few social contacts	1•2%	2•0%	••	••	••	••
Smoking	18•9%	17•0%	••	••	••	••
High alcohol consumption	0•5%	0•2%	••	••	••	1•5%
High bodyweight	11•7%	3•6%	••	••	4•2%	••
Low physical activity	2•5%	3•4%	••	••	••	••
Low fruit and vegetable consumption	7•0%	2•7%	••	••	••	••

Gap is calculated as the percentage difference between the observed gap in partial life expectancy between 35 and 80 years of age among the low and high educated. For values of relative risk used in sensitivity analyses, see appendix (p 4). *A scenario in which the prevalence of each risk factor among the low educated is the same as that among the high educated. A counterfactual scenario in which the prevalence of each risk factor is the same as that in the country with the lowest average prevalence and the smallest inequalities between low and high educated.

levelling resulting in an increase in partial life expectancy among women with a low-level education (and reduction of the gap in life expectancy between low-level and high-level education) of 0·5–1·0 years in eight countries among men and in five countries among women (figure B). The effects for the other risk factors were usually much smaller—ie, fewer than 0·25 years (figure B).

Among men, smoking was quantitatively important for the gap in life expectancy in all 15 countries, but more so in Estonia, Finland, Hungary, and Lithuania, whereas, among women, it contributed much less in France, Spain, and Switzerland. These differences can often be traced back to larger and smaller inequalities in smoking as shown in figure A. Among both men and women, low income contributed more to educational inequalities in life expectancy in central and eastern Europe than in most other countries, which can be traced back to differences between countries in the magnitude of educational inequalities in low income (figure A).

Contributions of risk factors can be compared between countries more easily when they are expressed as percentages of the gap in life expectancy in each country—ie, in relative instead of absolute terms (table 2). Smoking was the only risk factor that reduced the gap in life expectancy by more than 25% in some countries, both among men and women (table 2). The second and third largest contributors were low income and high bodyweight (table 2). As a weighted mean of all European countries, the contributions to the gap in life expectancy for smoking were 19·8% among men and 18·9% among women, whereas the contributions for low income were 9·7% and 13·4%, and those for overweight and obesity were 7·7% and 11·7% (table 2). However, large differences existed between countries in the relative contribution of risk factors. For example, among Belgian men, smoking (33·2%) clearly contributed more than high bodyweight (5·9%), but among Spanish men they were about equal (16·6% vs 14·6%; table 2). Among women, smoking contributed much less in France, Spain, and Switzerland than in the other European countries (table 2).

When we replaced the upward levelling scenario with a more realistic best practice scenario, the contributions of most risk factors declined substantially (table 3). The selection of best practice countries and detailed results for this scenario are given in the appendix (pp 6–12). For example, among men the mean contribution of smoking went down from 19·8% in the upward levelling scenario to 2·7% in the best practice scenario (table 3); this is unsurprising, because no country has small inequalities in smoking (ie, a prevalence ratio of <1·5) between men with low and high levels of education, so upward levelling cannot have a large effect. Among men, low physical activity contributed more than smoking in the best practice scenario (table 3). However, among women the mean contribution of smoking in the best practice scenario (17·0%) was only slightly smaller than that in the upward levelling scenario (18·9%; table 3). Among women, the three risk factors that contributed most were still smoking, low income, and high bodyweight, although low physical activity became a greater contributor relative to the other risk factors (table 3).

Our findings are also sensitive to assumptions about the effect of risk factors on mortality. When we took higher relative risks for father with a manual occupation (removing the adjustment for adult education from the relative risk estimate) or for low income (taking a controversial higher estimate from the published literature; appendix p 4), we found larger contributions of both risk factors to the gap in life expectancy, and the contribution of high bodyweight was substantially reduced when we took lower relative risks (taking less plausible lower estimates from the literature).

When we corrected for under-reporting of alcohol consumption as described by Rehm and colleagues,[18] the contribution of high alcohol consumption to the gap in life expectancy did not substantially change and remained much smaller than that of the other risk factors.

In general, the second and third sets of sensitivity analyses confirmed the findings of the main analysis for low income (large contribution) and high alcohol consumption (small contribution) and added some uncertainty to the findings for father with a manual occupation and high bodyweight (which might contribute more or less, respectively, than suggested by the main analysis).

Discussion

We found a substantial gap in partial life expectancy between people with low and high levels of education in all European countries. The risk factors contributing most to the gap in life expectancy were smoking, low income, and high bodyweight, but large differences existed between countries in the contribution of risk factors. Sensitivity analyses using a best practice scenario showed that the potential for reducing the gap might be considerably smaller, particularly for men.

In previous studies[19,20] we presented estimates of the contribution of six risk factors to educational inequalities in mortality and three risk factors to educational inequalities in life expectancy in a range of European countries in the early 2000s. This study represents an update and incorporates several improvements, such as use of national instead of regional data from Spain, inclusion of an indicator of childhood conditions, better estimates of relative risks, and addition of a series of sensitivity analyses.

Our study has several limitations. We relied on survey data with self-reported information on risk factors. A previous study[21] has shown that the magnitude of inequalities in smoking differs between surveys, probably due to differences in sampling procedures, non-response patterns, and survey questions, and the same might apply to other risk factors in our analysis. Inaccuracies in the measurement of risk factors, and the merging of risk factor categories, might have contributed to an underestimation of their contribution to inequalities in life expectancy in our study.

We did a dedicated sensitivity analysis for the risk factor that had the most evidence for misrepresentation in surveys (ie, alcohol consumption), but after adjustment its contribution to inequalities in life expectancy was still very small (table 3). These results contradict a previous study[22] that estimated the contribution of alcohol consumption to inequalities in mortality using alcohol-related causes of death, which suggest that its contribution is 10% or more in some European countries. One possible explanation is that our method assumes that the risk of mortality associated with heavy drinking is the same for low-level and high-level education, whereas it might be greater for people with low-level education—eg, because their pattern of drinking is more hazardous or because they benefit less from a supportive social network.[23] Further research is necessary.

The assumption that relative risks are the same for low-level and high-level education might also be unrealistic for other risk factors. Some studies have found that smokers with low levels of education have a greater likelihood of developing lung cancer than smokers with higher levels of education, perhaps due to differences in smoking behaviour (eg, deeper inhalation of tobacco smoke or more carcinogenic types of tobacco smoked) or biological susceptibility,[24] implying that the contribution of smoking to inequalities in mortality might be larger than estimated using equal relative risks. However, findings of studies[25,26] that estimated the contribution of smoking by use of smoking-related causes of death have produced estimates similar to those made in this study. We also assumed that the relative risks for mortality were the same for men and women, for all age groups, and for all countries in the study.

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